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AUTHOR Lesgold, Alan
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ABSTRACT

This article, written for psychologists, educators, and allied health professionals, is both a review of the "Handbook of Human Intelligence" Robert S. Sternberg, editor, and an essay in response to it. Following a note on the contributions made to the field of cognitive psychology by Sternberg and the Handbook, chapters of the book, which include conceptual issues, multiple definitions for intelligence, and a taxonomy of cognitive competencies, are reviewed. The contributed chapters in the Handbook, which focus on various aspects of intelligence are reviewed separately, with specific consideration as to how each aspect contributes to and broadens the definition of and research on intelligence. Areas which are covered include: psychometrics, perception and attention, learning and memory, intelligence as reflective thinking, mental retardation and the instructability of intelligence, education, intervention programs, the cultural relativity of intelligence, and intellectual development. The paper concludes with reflections on two issues that were generated by the author's reading of the book. The first issue is whether intelligence research exists as a separate field of inquiry within the broad study of cognitive psychology. Arguments in favor of a separate subfield as well as potential dangers (e.g., stagnation and research issues) are presented. The second concern focuses on a need for the teaching of intelligence in light of the information processing and transmission revolution. The movement of teaching, from specific skills, which are being taken over by computers, to skills in how to learn, and adaptation, is recommended. (BL)

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INTELLIGENCE: THE ABILITY TO LEARN, OR MORE?

ALAN LESGOLD

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**Intelligence:
The Ability to Learn, Or More?**

**A Review of
Handbook of Human Intelligence
by Robert S. Sternberg**

Alan Leagold

Learning Research and Development Center

University of Pittsburgh

1983

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Table 1: Definitions of intelligence seen in the *Handbook of Intelligence*

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Intelligence: The Ability to Learn, or More?
A Review of the Handbook of Human Intelligence¹
Handbook of Human Intelligence

R. S. Sternberg (Ed.)

New York: Cambridge University Press, 1982, 1031 pp, \$60.00

Alan Lesgold

This article is both a review of the *Handbook of Human Intelligence* and an essay in response to it. The handbook is monumental in size, scope, and importance. It can have many uses for educators and psychologists, and it has many strong points. What follows is a collection of specific comments on the volume and then reflections on two issues that reading it raised for me. The first issue is a question that arose as I read the various chapters in this volume: Is there really a separate field of intelligence research, or has it become as broad as cognitive psychology? The second is a concern about the need for more teaching of intelligence, in light of profound changes coming about as we enter an era in which human activity revolves around processing and transmission of information.

A Milestone Contribution

Robert Sternberg, the Handbook editor, has played a major role in shaping the research domain of intelligence as we know it today. While intelligence is a field in which a number of our most productive colleagues work, it is largely due to Sternberg that the field is seen as a separate discipline. He has created a journal and an *Advances* series, and his own program of research is both strong cognitive psychology and a strong personal viewpoint on what the study of intelligence should be. *Intelligence*, the concept, was born in the domain of psychometrics, but it will only be vital if attacked through the cognitive sciences. Sternberg is a central bridging force connecting these areas. Thus, it was certainly appropriate for him to lead a number of major psychologists and researchers from allied professions in the creation of this handbook.

One can question whether a handbook is a good idea for contemporary psychology, I suppose. The argument against one is that the field moves so quickly that few studies are still important five years after

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they appear. I believe that this point of view is too prevalent generally; it certainly does not apply in the present case. In the past few months, since I've read through the *Handbook*, I have several times recommended individual chapters to people who wanted to know where to start in pursuing a topic, and I see the book as an invaluable basis for some of the core courses that are taught to graduate students in cognitive psychology. There are already new articles that move beyond specific conclusions drawn in the volume, but it will continue for many years to be a good initial grounding for someone starting to do work in this area.

Sternberg's Chapters

This book is more than the sum of its chapters. While including a wide range of topics outside his own interests, Sternberg has, with associates, written three of the chapters himself in order to lend greater coherence to the effort. An initial chapter entitled *Conceptions of Intelligence* lays a foundation for the rest of the handbook. In defining intelligence as *goal-directed adaptive behavior*, Sternberg and Salter give one clear organization for the field as they see it. The cognitive approach is nicely introduced with discussions of procedural, strategic, and declarative aspects of intelligence. A variety of issues concerning the social contexts in which intelligence is exercised and acquired comes next, followed by discussion of biological, developmental, and instructional issues in the growth of intelligence. The rest of the book is organized by these basic concerns.

The direct influence of Sternberg appears a second time in a chapter on problem solving and intelligence, the area in which his own work has concentrated. He reviews the literature dealing with interactions between the domains of problem solving, reasoning, and intelligence. The review proceeds from a set of questions that are driven, in part, by Sternberg's own theoretical approach. For example, some of the questions are:

- What performance components are posited by the theory? (p. 229)
- Upon what representation or representations do these components act? (p. 230)
- What metacomponents are used in this form of reasoning? (p. 232)
- What are the salient sources of individual differences in reasoning or problem solving at a given age level, and how do these sources of individual differences manifest themselves? (p. 232)

The review ends with another definition of intelligence: *...the ability to acquire and think with new conceptual systems and to solve novel kinds of tasks* (p. 296). Sternberg's ability to provide multiple definitions of intelligence mirrors a plurality of views throughout the volume as a whole. In the concluding

chapter, summarizing the forms which theories of intelligence can take, Sternberg and Powell mention another definition of intelligence again, ...*the phenomena that ordinary people... have been referring to as "intelligence"* (p. 1001). Finally, in the same chapter, there is a table discussing aspects of intelligence. It bears the title *Taxonomy of Cognitive Competencies*. This chapter, as a whole, argues for a broadening of theoretical conceptions of intelligence, leaving this reviewer with the question of whether *intelligence* is a different domain from *cognition*. I return to this question in the last section of this review essay.

Contributed Chapters

Sternberg gathered a stellar cast of authors for the remaining chapters of the volume, including John Carroll, Lynn Cooper, William Estes, Jonathan Baron, Roger Schank, Ann Brown, Joseph Camplone, Richard Snow, Edward Zigler, Michael Cole, Harry Jerison, Sandra Scarr, and Robert Siegler. Members of this celebrated company have described the conference that launched this venture as one of the most valuable they have ever attended. The cast includes some of the most important, and consequently most overworked, members of our profession. Getting all the chapters contributed was undoubtedly a major chore, but Sternberg went much further. Many of the chapters bear signs of a serious editorial effort after coherence; they reference each other, build on each other, and are generally well written. Sternberg and the contributing authors have a final product they can be proud of. A few comments on some of the chapters follow.

Psychometrics

Perhaps the most important, in some ways, is the chapter by Carroll that, with the first Sternberg chapter, constitutes the introductory section of the book. Carroll provides a very insightful historical development of the concept of intelligence as created by psychometricians. There is excellent and broad coverage of the history of IQ testing by schools. An important idea in the chapter is that of *criterion-referenced intelligence testing*, the notion that we should have tests that tell us which intellectual tasks students can and cannot handle, not whether they are better or worse than their peers. This viewpoint (which has been proposed in other forms before) nicely cuts a path that other chapters follow, in which intelligence is treated as a set of specifiable capabilities for which we can test and which we may be able to train.

Perception and Attention

A chapter by Cooper and Regan addresses the question of the role of perception and attention in intelligence. It contains a very thorough review of efforts to relate various perceptual processing parameters to intelligence, concluding that speed of access to concepts in memory is correlated with verbal intelligence and that encoding speed is correlated with spatial processing proficiency. Evidence on the role of mental representation manipulation speed was found to be more equivocal. In any case, they point out that these three measures account for only a small amount of the variance in intelligence test scores.

Cooper and Regan also explore the possibility that there are attentional and/or strategic components to intelligence. Like most of us, they suspect such components exist. However, they point out the need for much more and much better research before meaningful accounts of such aspects of intelligence are likely, noting that it is hard to understand individual differences in attention and perception since we do not yet have good understanding of those mechanisms. I see no reason, though, why research on such individual differences might not be as likely to drive research on the basic mechanisms as vice versa, so long as the eventual need for a mechanistic theory is kept in mind.

Learning and Memory

Estes, in a careful analysis of the relationship between intelligence and learning and memory, gives us another definition of intelligence to add to our collection. *...intelligence [is] adaptive behavior of the individual, usually characterized by some element of problem solving and directed by cognitive processes and operations.* This represents a specialization of some of the definitions already given--intelligence is to be taken as involving operations on mental representations. In the context of a solid, careful review of the status of our knowledge about learning and memory, Estes takes a position separating learning from intelligence. Intelligence for Estes seems to be a *property* of behavior; it is jointly determined by cognitive function and by motives. This is quite different from intelligence as the ability to learn or intelligence as a set of performance parameters for the cognitive apparatus.

Intelligence as Reflective thinking

Baron, in a chapter labeled *Personality and Intelligence*, proposes a theory of thinking which contains a development of the notion of *reflective thinking* as a primary component. He suggests that such a theory could serve as a framework for studying *individual differences in thinking*, though he does not suggest that intelligence and extremity on measures of thinking traits are necessarily the same. He also tries to demonstrate the close relationship between personality development in general and the development of intelligence. In all of this, he teeters on the edge of a claim that intelligence is a family-resemblance concept (in the sense of Wittgenstein) that does not have a specific set of defining characteristics. As will be discussed below, this matches well with the many different definitions provided in the *Handbook*. Overall, the chapter prompts much reflection on the nature of intelligence but does not fulfill the encyclopedic function some might propose for a handbook. Perhaps it is this tendency throughout the volume to emphasize issues for reflection and to provide essays based upon expert reflection that leads me to believe that the volume will remain valuable for quite a while.

Can Intelligence be Taught?

Perhaps the *tour de force* of the entire volume is the chapter by Camplone, Brown, and Ferrara, on *mental retardation and intelligence*. I have already made substantial use of the chapter in some of my own work and have sent others to it. It is a strong exploration of a central issue on which the advice of psychologists is regularly sought: *Is intelligence teachable?* The chapter goes beyond the set of interests one usually thinks of as involving mental retardation and sets the stage for a general theory of the instructability of intelligence, especially when intelligence is thought of as the ability to learn efficiently. Literature on this topic, including the authors' own extensive work, is reviewed thoroughly and with great insight.

One statement made in this chapter bothers me:

...we have chosen to exclude... more traditional psychometric work. We have omitted it because our own approach to the area of exceptionality differs from that of traditional test builders and psychometrically oriented theorists in one important way. Our (eventual) aims are both improved diagnosis and remediation. *The goal of reducing the problems encountered by slow learners requires a more detailed and elaborate process analysis than does the construction of standardized tests, a task in which the products of previous experience can provide all the information necessary* (emphasis mine). Thus we are concerned with the components of intelligent functioning rather than with its correlates or products. (p. 307)

It may well be reasonable to exclude much of the traditional psychometric work on these grounds, but this should not mislead the reader into believing that the field of psychometrics can continue to take a correlational approach that ignores analysis of cognitive processes any more than any other aspect of cognitive science can. Of course, it is also true that the field of psychometrics sorely needs a theoretical base for such problems as item generation. For this, a synthesis of cognitive psychology and psychometrics is needed, not a wholesale replacement of the wisdom of decades of testing research.

I believe that empirical methodologies have not quite kept up with the rich evolution of cognitive theories in recent years. We need to find better ways of validating our theories, including our theories of intelligence. The efforts of several decades of work on reliable means for measuring aspects of intelligence should not be discarded without considerable reflection on specific measurement concepts that were developed by psychometricians. We need all the hints we can find. Of course, the Brown-Camplone laboratory has contributed richly to the methodology that has developed, too, but more is needed and some of it may derive from traditional test item generation procedures and other psychometric contributions.

Education and Intelligence

A chapter by Snow and Yalow presents a scholarly overview of the ways in which intelligence as a concept has influenced education from early times to the present, along with a good summary of work on the cognitive psychology of intelligence and learning that is of especial relevance to education. For a cognitive psychologist who wants to understand how research relating to intelligence could impact education, the chapter is an excellent starting point. For educators wanting to find out about the cognitive psychology of intelligence, I strongly recommend going beyond this chapter. To a large extent, the set of researches that have directly considered educational problems represents only a smattering of the defining studies of thinking and intelligence. While the chapter does a good job of explaining *why* educators should be interested in the cognitive psychology of intelligence, the other chapters and the works they cite are necessary reading if any serious understanding is to develop.

Intervention Programs

A chapter by Zigler and Seltz addresses social policy issues relating to intelligence. It deals largely with issues relating to intervention projects designed to improve the prospects of identifiable groups of children who would otherwise not be expected to do well in school or on the job. On first reading the chapter, I was worried about their assertion that improving *social competence* rather than improving *intelligence* ought to be society's goal. However, the chapter proved to be a solid review of the effectiveness of intervention programs, the problems in documenting program effectiveness, and the complexities of environmental issues that perhaps have more influence than direct instruction. The following quotation seems a good summary of the kinds of issues addressed in their chapter:

It may seem undramatic to end a discussion of social policy implications of research on intelligence with a recommendation of family support programs. It would certainly be more eye-catching to point to new cures for retardation or training procedures that create geniuses. But as we have argued in this chapter, our knowledge base generally does not support expectations that changes in societal practices will effect drastic changes in intelligence....

Despite these difficulties, psychological research on intelligence does have social policy implications.... there is good reason to believe that several kinds of intervention can raise functional levels of intelligence for persons whose measured IQ is commonly low. There is further evidence that a thoughtful coordination of these various interventions could help many children and their families to adapt better to society and to achieve a better quality of daily existence.

I personally am inclined toward a more cognitive and more futuristic view. We are becoming a society with an increasing gap between the opportunities available to a technological elite and a mass populace displaced by automation. Much of what it takes to be in the elite group comes under the heading of

intelligence as adaptive capability. Those with lesser amounts of these capabilities may need to have their entry into a good life engineered through training approaches we have yet to consider. A caricature of the Zigler and Seltz paper is that such engineering is unlikely to go well, while some family support programs have been proven to produce improvements. I believe we must continue to try more direct approaches as well, even though past successes are hard to establish, and even though what may have worked so far may later fail because of the striking changes produced as we move toward an information economy. I will return to this issue near the end of this review.

Cultural Relativity of Intelligence

A chapter by the Laboratory of Comparative Human Cognition (the ego-free *nom de plume* of Michael Cole's Laboratory) addresses the problem of cultural specificity of intelligence. As Cole has said in other forums, it is quite shocking for a cognitive psychologist to go to another culture and be outsmarted there by people who undoubtedly would not score all that high on an IQ test. The LCHC chapter, after showing why significant linkages between cross-cultural anthropology and the study of cognition are difficult, goes on to consider the role of culture in intellectual development. It contains many useful references to a later chapter by Siegler and Richards that is written from the viewpoint of developmental cognitive psychology. The LCHC authoring team suggest that culture influences children's environments, and hence their cognitive development, in four ways: (a) through variation in the occurrence or non-occurrence of specific basic problem-solving environments; (b) through variations in the frequency of problem-related events; (c) through the patterns of co-occurrence of events; and (d) through regulation of the level of difficulty of problem tasks the child encounters. Vygotsky's concept of *zone of proximal development* is explored in connection with this analysis. This concept has only recently been accorded the attention it deserves and has yet to be treated by many learning theorists or researchers specializing in simulation modeling of cognitive processes.

Intellectual Development

After two very good chapters on the evolution and the genetics of intelligence (of less concern to educators, I will assume), the chapter on intellectual development by Siegler and Richards follows. The chapter compares Piagetian, psychometric, and information-processing approaches to the study of cognitive development and ends with 10 specifically stated conclusions. Siegler and Richards emphasize the importance of multiple approaches to the study of development. They also highlight the important contributions of existing knowledge and of how a given situation is encoded to whether an individual behaves intelligently in that situation. Summarizing their discussion, they suggest that the dramatic stage-like changes in cognitive competence may be a function of how one tests for competence and/or the environment(s) in which competence is acquired.

Summary

All told, the thousand pages of this handbook provide an excellent overview of significant (and primarily psychological) views of the nature of intelligence. It is a very important contribution to cognitive psychology and other allied fields. Chapters in the area of neurophysiology and psychobiology as related to intelligence had also been planned but did not materialize, and a planned contribution in the area of artificial intelligence had to be replaced at the last minute. A summary paper was contributed by Dehn and Schank, instead. It is a good summary but not as extensive a contribution as some of the others. Since my interests lie in that direction, I wish the authors had been part of the project from the outset, so we could have more elaboration of the overview they provide. Nonetheless, the book as a whole is a masterpiece. It also presents such a broad view that one can extract at least ten different senses of the meaning of the word *intelligence*. These are shown in Table 1.

Table 1 about here

Is It a Separate Field?

Because so many different senses of the nature of intelligence were presented, I got through most of the *Handbook* before I was able to stop worrying about whether intelligence is really separate from cognition in general. Indeed, I still feel that all cognitive psychologists should know what is presented in the *Handbook* and that the training for someone interested in intelligence should be grounded in a discipline such as cognitive psychology, cultural anthropology, or computer science. However, I now am more sanguine about the potential for a subfield of research that is multi-disciplinary and devoted to issues of intelligence. I still feel that a set of applied concerns is needed to give focus to this subfield.

The argument in favor of having a separate subfield is that psychologists studying intelligence need to be in contact with allied disciplines whose results can help illuminate phenomena that involve more than a context-free set of cognitive capabilities. Also, it is essential, as I argue below, that intelligence be studied with a view toward the problems our society faces now that moderate levels of intelligence are found in machines as well as in humans. The danger I foresee, though, is that as an interdisciplinary agenda rather than a separate science, the subdomain of intelligence could eventually stagnate. In fields such as developmental psychology, people are sometimes hired or not according to whether or not they are *really* developmentalists. Work on intelligence will best be done by people who are sufficiently immersed in a discipline, such as cognitive psychology or cultural anthropology, that they will sometimes be attracted to problems outside their focus on intelligence. This should be encouraged, and so far things are going well. Vigilance is required, however, to assure that what holds the field together is expertise relative to a common set of research issues and not abjuration of concern with other related topics on which the study of intelligence must feed.

Intelligence and the Information Revolution

Having spent substantial time with this volume, being taught or sometimes reminded about intelligence from many points of view, a related issue concerns me: *Are we studying intelligence with sufficient concern about improving it?* Certainly there are scholarly programs that involve intelligence, and these should continue. However, I believe that any capabilities for teaching intelligence that we can develop and exploit rapidly are crucial to at least the short-term prospects for our society.

It is almost a cliché to say that we are experiencing a revolution, wrought by the computer, that rivals the industrial revolution. Like many clichés, however, it is also true. Because machines can be built that behave relatively intelligently, the value of average and mediocre intelligence is being depreciated. In those domains where the average, or slightly below average, person could do well, machines are taking over, devaluing the importance of the human worker who has not acquired new aptitudes for success in an information economy. As a result, I believe that compensatory instructional programs designed to bring cognitive performance levels up to the level of the *average* or *almost average* person will be less valuable in the future, especially if they concentrate on the kinds of skills machines handle well. On the other hand, training in skills selected with reference to the changes in our economy could be very promising. The possibilities can be seen from several different points of view.

One point of view, found in parts of the *Handbook*, is that intelligence is the ability to learn from incomplete or inadequate instruction. Certain approaches to occupational training are implicitly grounded in this view. If we develop a sounder curriculum for training a skill, then less intelligence will be required to learn from it. So, for example, the character of courses in the use of word processing tools changes as more of our society becomes involved in using them. New courses emphasize explicit procedural training more than abstracted principles, avoiding the need for the intelligent capability to apply an abstract principle in a new concrete situation. This approach can only succeed if we emphasize not the rote learning of tasks a machine will soon absorb but rather the human aspects of dealing with word processing systems. Perhaps word processing operators should be trained more as interfaces between text generating people and a text processing resource and less as rote symbol enterers. Building of well-trained human-machine teams might well be the goal. Such teams will need human captains.

More generally, the things we understand well enough to teach to the less intelligent, we can also teach to the computer. Thus, I find that many of the occupational training programs we have today teach specific skills that will rapidly become obsolete. This is a recent change. My father and I learned the same industrial arts skills in junior high school, and after graduation either of us could have found many jobs using these skills. Today, very little of that curriculum is still occupationally relevant. Ironically, the more successfully a particular occupational specialty can be taught, the sooner it will be automated away.

Particularly tragic are courses emphasizing "computer training." Some of these courses teach only the low level coding of pre-determined algorithms, a role about to be assumed by automatic programming systems.

We do not know for sure where the jobs of the future will lie. Some say that janitorial and other service jobs are most likely to dominate. Others expect the growth of industries to be more directly stimulated by the computer, leading to more high-technology positions. Perhaps all are correct. A more principled way to plan education for this complex future can be derived from the views of intelligence expressed in the *Handbook*. First, there is intelligence as the ability to learn in less than optimal training environments. Second, there is the culturally-relative view of intelligence. Both views can provide ideas about how to help the majority of our fellow humans, those who are not guaranteed positions among the technology elite.

From the viewpoint of intelligence as a set of learning skills, we see that humans will be needed exactly where we don't understand a domain well enough to design foolproof instruction. This suggests that learning to learn skills are a particularly critical aspect of intelligence that we must learn to teach. The successes reported by Camplone, Brown, and Ferrera are heartening, but much more effort must be invested in the specification and training of learning skills, which our children will sorely need. Teachers will also need learning skills, because they will need to make more rapid adjustments to the contents of the curriculum. Teaching requires both specific knowledge and more general intelligence. Many teachers have good learning skills, but I suspect some could benefit from instruction in how to learn, how to reason, and how to abstract formal or numerical representations from a situation.

In addition, teachers will need more than purely cognitive capabilities, as always. For example, there are aspects of motivation and leadership involved in teaching children that will not be readily imparted to machines. As computers enter the classroom, teachers will need to work with them, as leaders, stimulators, and troubleshooters, filling the roles machines do not fill well. This partnership will be essential in other areas as well. Many of our interactions with computers are frustrating, because the machines were programmed by people who could not anticipate the specific demands we might make on them. Learning and problem solving skills will be needed by those who hold the inevitable jobs concerned with troubleshooting man-machine interactions, in banks, at telephones in business credit departments, in stock rooms of factories, and at government information centers. Today, these helping roles are undervalued, partly because they are often filled by people who think less flexibly than the machines they work with. Can we teach some of the skills that would permit such people to do a better job?

The problem of interacting with a computer programmed by someone from a different culture is particularly great. I have found it intriguing on several occasions to watch people who are not from middle-class, business-oriented backgrounds interact with automatic bank teller machines. Some people try

repeatedly to get money from an overdrawn account, or they ask a friend to try using the card instead. Given my knowledge of the banking system and the people in it, this seems fruitless. However, in other cultural settings, one sometimes succeeds in getting money by asking for it several times, and there are cases when a friend has better connections for this purpose. It seems to me that there will be a role in the future for people who can translate between the constraints of one culture and those of another, and that this sort of skill should be a target for improved instructional programs. The aptitudes for accommodating different cultural viewpoints may be quite different from those for high technology jobs. Both types must be fostered.

I have been suggesting that the very things that seem the hardest to do, teaching learning skills and adaptive troubleshooting capabilities and teaching culture-specific skills of guidance and leadership, will be more productive in future efforts to help the less intelligent. Chapters in the *Handbook* tell us this will be hard, and that successes have seldom been demonstrated in the past. However, the value of the sort of inflexible, untransferable skills traditionally taught to the less intelligent will be depreciated in a society where machines can learn to do anything we can teach really well and where productive social roles keep shifting. We simply have to keep trying--to discover the essential skills of learning and adapting in a computer-rich society and to learn how to teach those skills to a variety of people.

We must also recognize that forms of intelligence which involve capabilities of leadership and wisdom will be particularly valued. Thus, cross-cultural studies of intelligence will be important as will cognitive studies of social leadership skills. Again, what will be critical is discovering how to teach such skills. Also, we will need to build a theory of the organization of intelligence to accomplish tasks that require groups of people or machines to work together. There was no chapter on the organization of intelligent efforts in the *Handbook*, and I am hard pressed to think of anyone who could write one. However, the problem is already being addressed in computer science, and it merits attention from psychologists and educators as well.

The industrial revolution triggered the need for new sciences and technologies, including many forms of engineering, physical studies of energy transfer, and materials sciences. Similarly, the information revolution will require continued efforts in the study of intelligence and cognition as well as underpinning sciences of information processing and information transmission. Intelligence is the ability to adapt to changes in circumstances, to learn how to handle such changes. The advent of automatic information processing will continue to produce changes in how we can be valuable to each other. Therefore, the need for skill in learning and solving problems will increase, even as traditional problem solving environments are taken over by the computer. The educator's task, as this happens, will be enormous, and banking on simple solutions that have worked in the past will not be sufficient. A substantial research base will be needed if we are to do better. As the *Handbook of Intelligence* demonstrates, this is starting to appear.

However, unless future efforts are driven more by our need to learn how to teach children who will be living in a world dominated by its reliance on intelligent machines, those efforts will not be sufficiently focused to be useful.

- Goal-directed adaptive behavior.
- The ability to acquire and think with new conceptual systems.
- The ability to solve novel kinds of tasks.
- Problem solving ability.
- Planning and other metacognitive skills.
- The ability to learn from imperfect instruction.
- Memory access speed.
- Spatial representation encoding speed.
- What people think is intelligent.
- What IQ tests measure.

Table 1: Definitions of intelligence seen in the *Handbook of Intelligence*